(NASA-CR-134128) ENGINEERING REPORT. PART 1: NASA WHEEL AIR SEAL DEVELOPMENT FOR SPACE SHUTTLE TYPE ENVIRONMENTAL REQUIREMENTS (Goodrich (B. F.) Co.) 43 p HC $4.25 CSCL 11A G3/15

N74-11306

Unclas 22833

B.F.Goodrich Aerospace & Defense Products
A Division of The B.F.Goodrich Company
Wheel and Brake Plant
Troy, Ohio

NASA Contract No. NAS-9-12049
DRL No. Exhibit "A"
Line Item No. 9
DRD No. MA-129T

ENGINEERING REPORT NO. 4239
NASA Wheel Air Seal Development for Space Shuttle Type Environmental Requirements
January 23, 1973

PART I

B. F. GOODRICH AEROSPACE & DEFENSE PRODUCTS

Wheel and Brake Plant

Troy, Ohio

H. C. Sunderman
Chief Engineer

ABSTRACT

NASA WHEEL AIR SEAL DEVELOPMENT

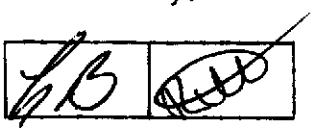
The investigation covers the sealing techniques required for existing aircraft wheel-tire designs to meet the hard vacuum 10^{-5} torr and cold temperature -65°F requirements of space travel. The investigation covers the use of existing wheel seal designs (Aerospace Standard AS666A and Military Standard 33649) along with an Omniseal® design consisting of a flat helical spring inside a C -section teflon ring.

PRECEDING PAGE BLANK NOT FILMED

TABLE OF CONTENTS

Written by:
L. D. Bok

Checked by:



INTRODUCTION

Existing aircraft type wheel-tire designs are being considered for use on the space shuttle. Previous environmental testing of a F4J wheel and tire assembly to the space shuttle type environment showed that the air seals for the split wheel and fuse plug leaked.[1] The air leakage rate over the long term mission would cause the shuttle to land on seriously under-inflated tires. This investigation covers the evaluation and improvement of the sealing techniques for the split-wheel, fuse plug, and inflation valve.

CONCLUSIONS

1. The environmental testing has demonstrated that aircraft wheel and tire assemblies can be made to meet the long term exposure to the requirements specified on Page 3.

2. A modified Aerospace Standard AS666A seal configuration and an Omniseal® made by Aeroquip Corporation will meet the requirements for the split-wheel air seal.

3. Military Standard MS-33649 seal configuration will meet the requirements for the inflation valve and fuse plug air seals.

RECOMMENDATIONS

1. The existing aircraft wheel seal designs (Aerospace Standard AS666A and Military Standard MS33649) are recommended for the space travel application. The Aerospace Standard AS666A must be modified to hold the squeeze of the O-ring to high limit (approximately 30% squeeze) and the finish of the sealing surface to a 32 RMS or better.

2. Acceptance tests at -65°F and atmospheric pressure should be performed on all wheel and tire assemblies prior to mounting on the spacecraft to check tire diffusion rate and wheel seal leakage. Passage of this test should assure that the wheel sealing surfaces were not damaged during tire change or wheel assembly, and that the assembly will meet the environmental requirements.

PURPOSE AND SCOPE OF INVESTIGATION

The purpose of this investigation was to determine sealing techniques for the large split wheel air seal, fuse plug, and inflation valve seals that would be adequate for space shuttle type application.

The program consisted of the following:

A. Selecting the most promising seal configurations for the application.

B. Verifying by individual tests at atmospheric pressure that each seal configuration will meet the cold temperature requirements.

C. Demonstrate that a 49 x 17-20 wheel and tire assembly using these seals will meet the space shuttle type environmental requirements as duplicated by the NASA test chamber at Houston, Texas.

ENVIRONMENTAL REQUIREMENTS

The wheel and tire exposed to a pressure of 10^{-5} torr and a temperature of -65°F for a period of seven days must not lose more than 5% of the original tire pressure. (Corrected for temperature and pressure to standard day readings). Ref. NAS-9-12049 Specification, Exhibit "A", Paragraph 3.3.1 [4]

Review of Environmental Requirements

The environmental requirements for the space shuttle produce two sealing problems for the wheel seals.

1. Sealing a Hard Vacuum

   The problems involved in sealing a hard vacuum are sublimation of conventional elastomer and gas permeability of the elastomer. The sublimation of the elastomer results in loss of body weight and possible change in physical properties of the seal. The sublimation of the seal can be controlled by the seal geometry for only those molecules on the surface are moved. The gas permability can be minimized by selection of the elastomer.

2. Sealing at -65°F

   The problems involved in sealing at -65°F are the interactions between the coefficient of thermal expansions, the resilience of the elastomer or seal at cold temperatures, and the finish of the sealing surfaces. An elastomer seal seals on its ability to follow the contour of the mating sealing surface filling its voids. As the temperature decreases, the seal loses its resilience or ability to follow the contour of the mating sealing surface. A shift in the seal contact area due to change in temperature and the differences in thermal expansion could cause leakage.

DISCUSSION OF RESULTS

Split Wheel Air Seal

Two split wheel air seals were selected based primarily on the cold temperature requirements.

1. Aerospace Standard AS666A

Aerospace Standard AS666A shown in Figure 1 is a specification for seal cavity design for static seals used in aircraft tubeless tire wheels. This design was selected as the best O-ring type seal configuration based on past aircraft wheel experience. The O-ring compound selected was Parker Seal Compound E600-7 with a hardness of 70 Shore A. This compound is basically an ethylene propylene selected for its temperature range of -65°F to 300°F. The compound is not specifically designed for high vacuum properties but satisfactorily passed the space shuttle type environmental requirements.

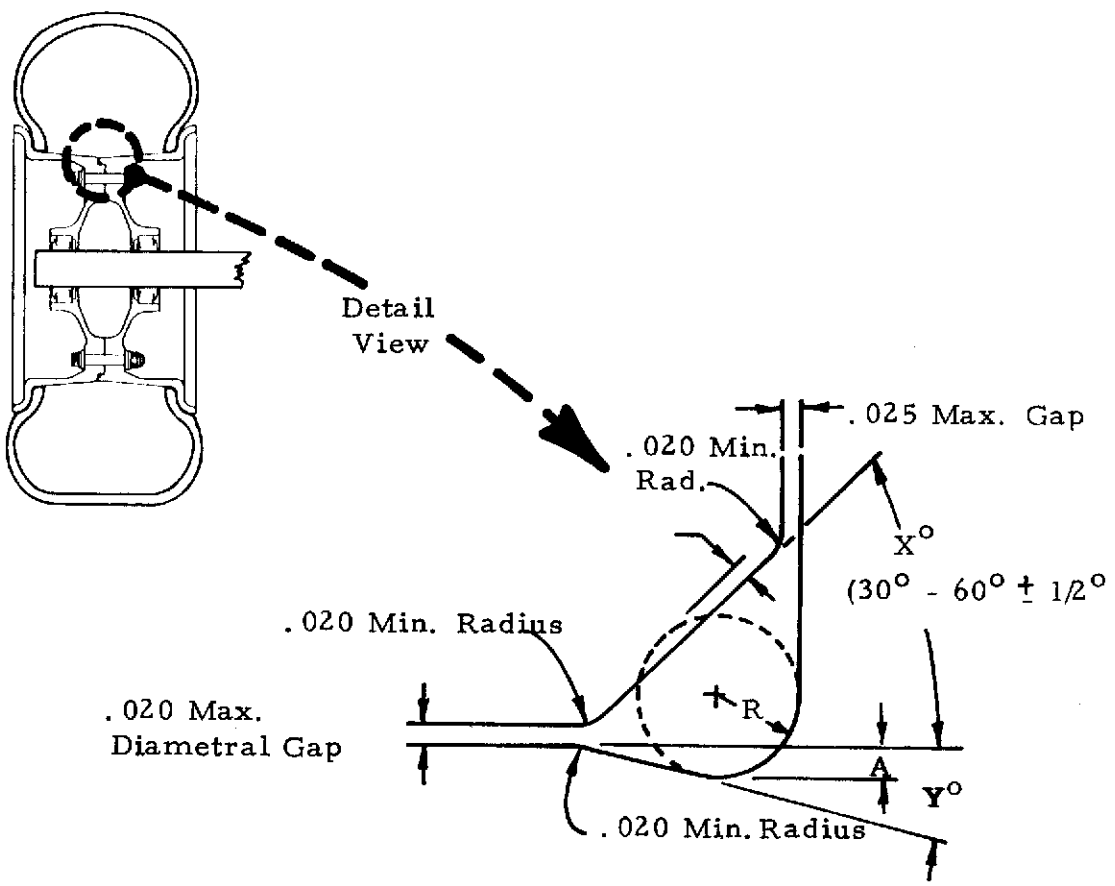


Figure 1
Aerospace Standard AS 666A

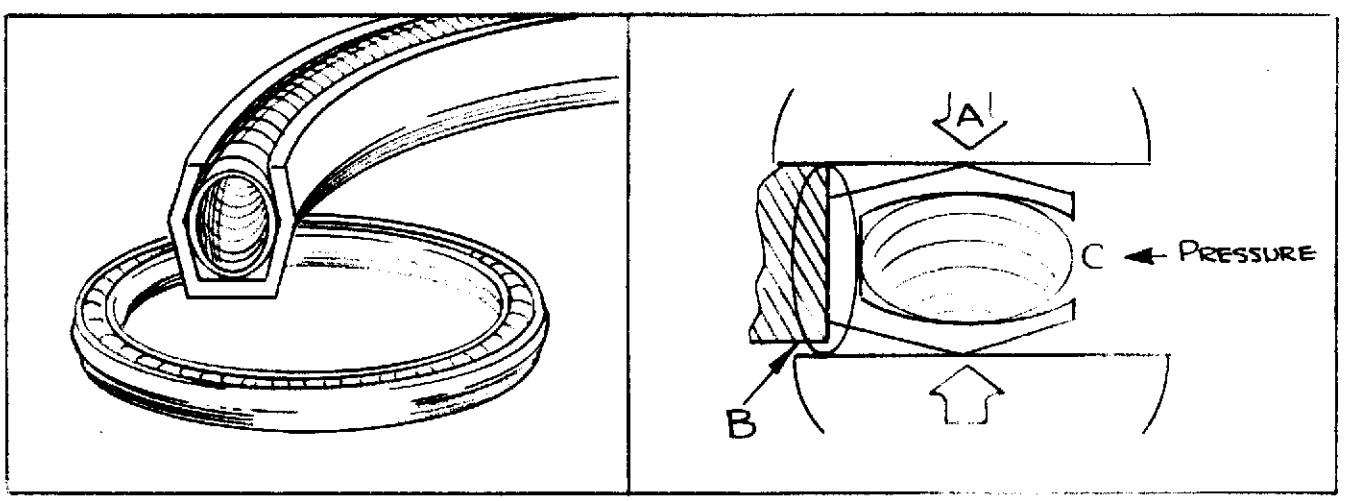
DISCUSSION OF RESULTS (CONT'D)

1. Aerospace Standard AS666A (Cont'd)

The modified Aerospace Standard AS666A seal configuration passed all cold tests at -65°F with only minor leakage when a rapid temperature fluctuation occurred. (Test results are listed in Appendix A). The temperature fluctuation was caused by opening the test chamber door for 15 to 20 minutes after the test chamber had stabilized at -65°F. The leakage stopped once the temperature stabilized. All sealing surfaces for these tests were 32 RMS or better. O-ring squeeze ranging from 15% to 32% passed the requirements.

2. Aeroquip Corporation Omniseal®

The Omniseal consists of a flat helical spring inside a C -section teflon ring as shown by Figure 2. This design was selected for both its stability in a hard vacuum, (Stable to pressure of 10^{-7} torr)[2] and its temperature range of -423°F to 500°F.[3]



The Omniseal consists of a flat helical spring inside a C-section Teflon ring. Pressure actuated. . .system pressure enters inside of Omniseal and produces a "pressure to pressure" seal that is self compensating as pressure increases, decreases or impulses.

Omniseals are permanently resilient and provide (A) high unit loading of sealing surfaces, (B) flat heel-to-gland support which assures stable positioning of seal to prevent roll out. A flat, ribbon-type internal spring, (C) assures maximum seal support and reliability of performance.

Figure 2
Aeroquip Omniseal®

DISCUSSION OF RESULTS (CONT'D)

2. Aeroquip Corporation Omniseal® (Cont'd)

The Omniseal, when tested with the seal cavity specified by Aeroquip Corporation as shown in Figure 3, passed the -65°F temperature requirement. (Test results are listed in Appendix A.) A rapid temperature fluctuation did not cause leakage with the Omniseal as it did with the Aerospace Standard AS666A configuration. The test demonstrated that the Omniseal could be made to meet the cold temperature requirements. This investigation did not attempt to define the design criteria for the Omniseal. This design criteria should be specified by Aeroquip Corporation for each seal size and application.

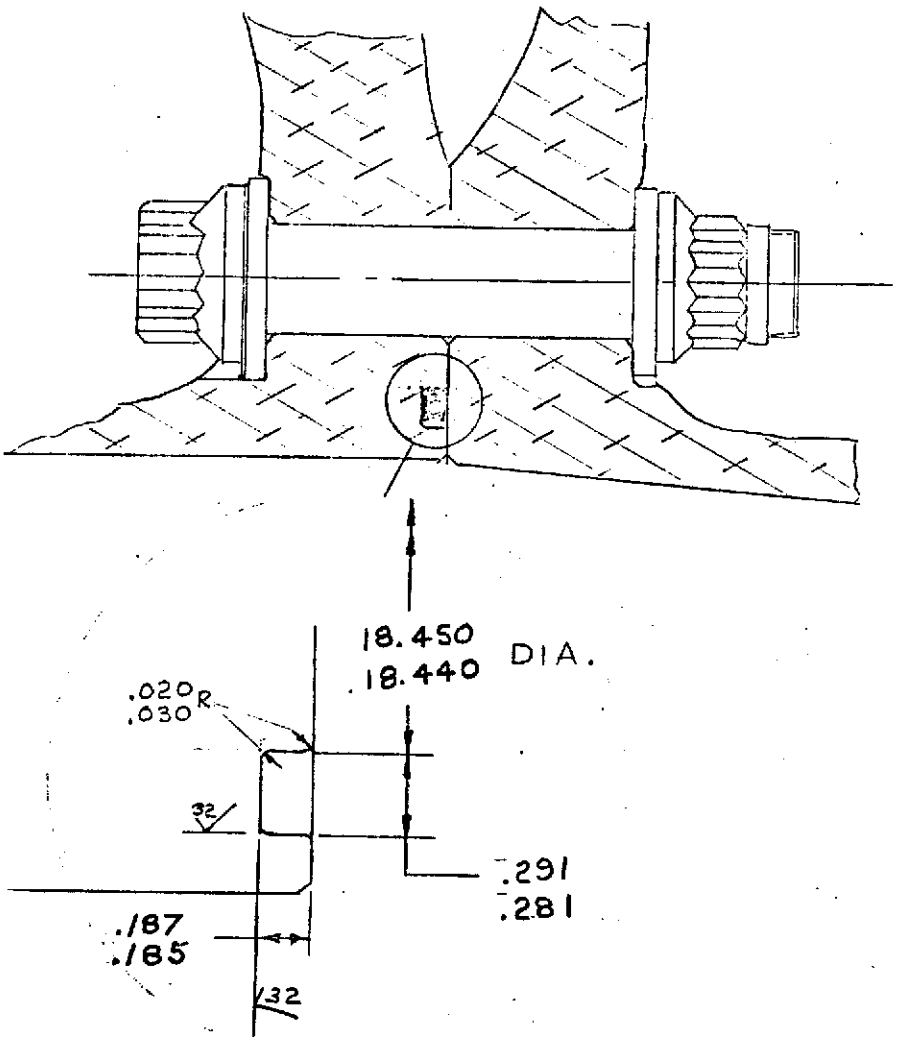


Figure 3
Split-Wheel Omniseal Seal

DISCUSSION OF RESULTS (CONT'D)

Inflation Valve and Fuse Plug Seals

The seal configuration selected for the inflation valve and fuse plug seals was the MS-33649. This seal configuration is the military boss specification for straight thread tube fitting O-ring gaskets. This configuration was selected for its confinement of the O-ring.

The O-ring selected was molded to MS-28778 dimensions by Precision Rubber Products Corporation with their Compound 7377.

The seal configuration when tested with the MS-33656 flared tube connection or MS-9015 machine thread O-ring seal, as shown in Figure 4, passed the cold temperature requirements. (Test results are listed in Appendix A.)

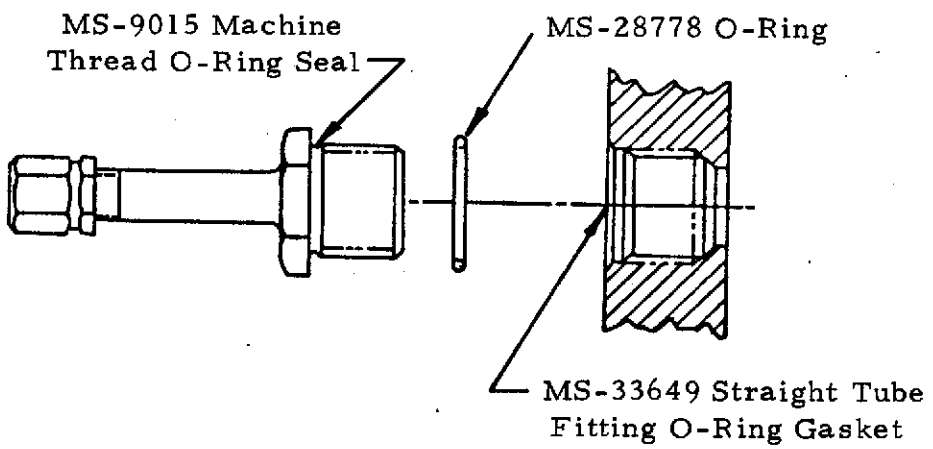


Figure 4
Inflation Valve and Fuse Plug Seal Configuration

DISCUSSION OF RESULTS (CONT'D)

NASA Environmental Testing of Wheel and Tire Assembly

Two 49 x 17-20 split tiebolt wheel tire assemblies were sent to NASA, Houston, Texas, for environmental testing as specified in the Environmental Requirements. The test assemblies were as follows:

Wheel and Tire Assembly No. 1

A.	Wheel Assembly	B.F.Goodrich P/N 3-1342-2, except without bearing, heat shield, wheel inserts, and fuse plugs.
B.	Split Wheel Air Seal	Omniseal, P/N AR214D18450A1Q
C.	Inflation Valve Seal Configuration	MS-33649
D.	Tire	C5A Tire Manufactured by B.F.Goodrich, S/N 2098AK0736

Wheel and Tire Assembly No. 2

A.	Wheel Assembly	B.F.Goodrich P/N 3-1342-1, except without bearing, heat shields, and wheel inserts.
B.	Split Wheel Air Seal	P/N AS666A, as shown in Figure 2, using 29.7% squeeze.
C.	Inflation Valve and Fuse Plug Seals Configuration	MS-33649
D.	Tire	C5A Tire Manufactured by B.F.Goodrich, S/N 2098AK0190

DISCUSSION OF RESULTS (CONT'D)

Test Results

Both wheel assemblies passed the environmental testing at NASA. The environmental testing lasted for a period of 184 hours from the time the pressure and temperature in the test chambers started dropping until the time and tire temperature stabilized at room temperature at the end of the test. Wheel and tire assemblies Nos. 1 and 2 lost 1.0% and 1.25% of the original tire pressure respectively during this test period. The allowable pressure loss was 5% of the original tire pressure. (Test results are listed in Appendix B.)

REFERENCES

1. NASA Manned Spacecraft Center, Thermochemical Test Area Document No. MSC-03884.

2. The Effects of Space Environments on Insulation of Teflon® TFE and FEP Resins - C. E. Jolley & J. C. Reed, December 1962.

3. Aeroquip Corporation Bulletin 299, Copyright 1966.

4. NASA Manned Spacecraft Center, Contract NAS-9-12049, Exhibit "A." Lightweight Wheel and Brake Subsystem.

APPENDIX A

COLD TEMPERATURE TESTING (-65°F) OF WHEEL AIR SEALS

Introduction:

The seal configurations selected for the space shuttle application were screened by determining if they would meet the cold temperature requirement. Seals meeting this requirement were assembled into a wheel and tire assembly and sent to NASA, Houston, Texas, for space shuttle type environmental testing. Appendix "A" presents the cold temperature test data.

Test Procedure

Test fixtures were designed for each of the seals selected to isolate and pinpoint the leakage areas. The seals were tested at an internal pressure of 300 psig at temperatures of -65°F for a period of 72 hours. The leakage rate was determined by water displacing method as shown by the test set-up in Figure 1. All seals with a leakage rate not exceeding 10 cc/min. were considered acceptable. The 10 cc/min. leakage rate represents approximately a 5 psi pressure drop over a seven day period for a 49 x 17-20 wheel and tire assembly with an initial pressure of 300 psig.

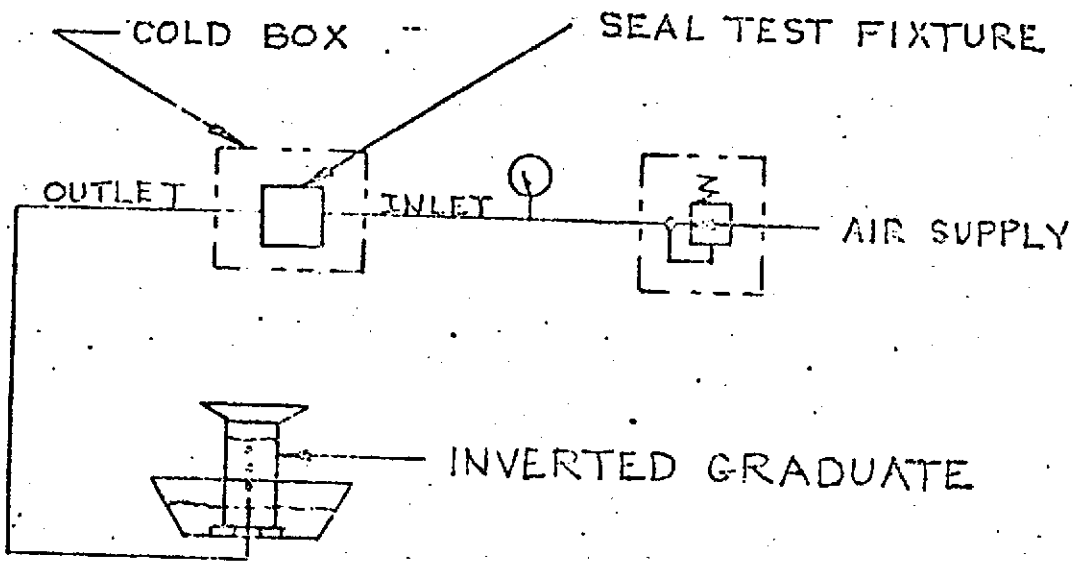
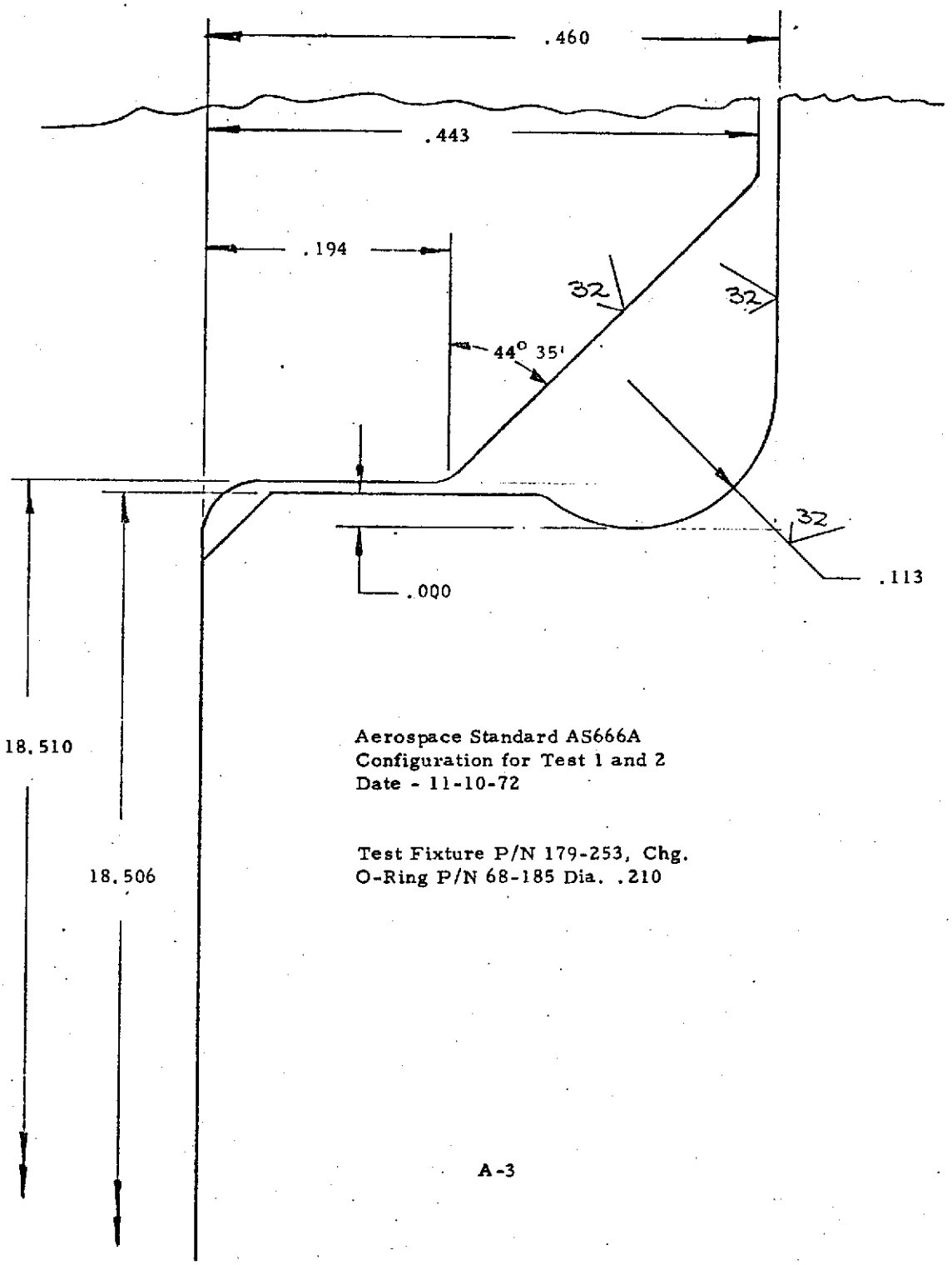


Figure 1
Seal Test Setup

Seals Tested	Test Fixture
A. Split Wheel Air Seal	
1. Aerospace Standard AS666A	P/N 179-253
2. Omniseal AR214D18450A1Q	P/N 179-257
B. Inflation and Fuse Plug Seals	
MS-33649	P/N 179-255

Test Results:

Data sheets on page A-3 through A-21 shows the seal configuration and corresponding cold test results.



Aerospace Standard AS666A
Configuration for Test 1 and 2
Date - 11-10-72

Test Fixture P/N 179-253, Chg.
O-Ring P/N 68-185 Dia. .210

Data Sheet No. 1

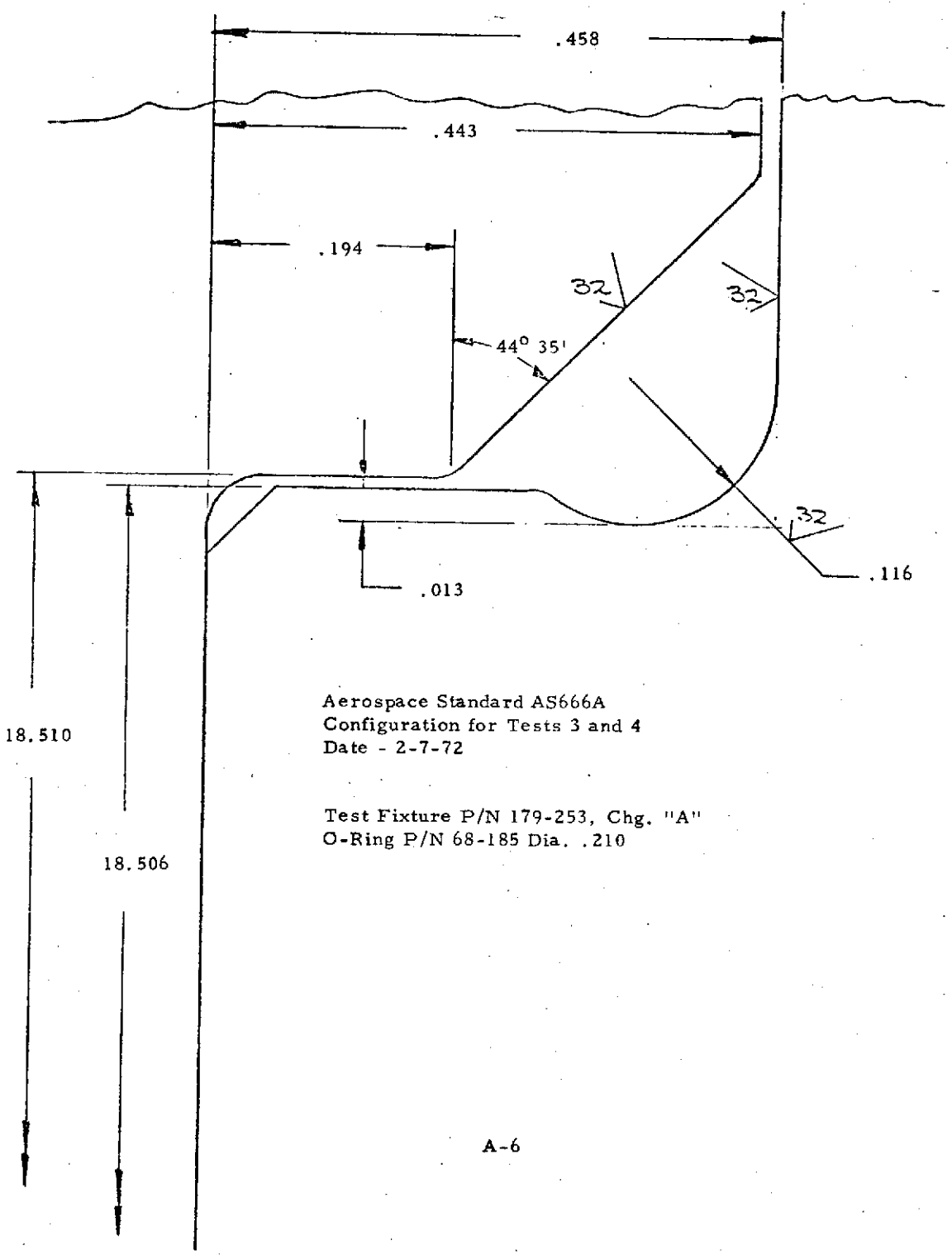
Test No. 1 Date 11-10-71
Seal 68-185
Compound Parker E600-7 Hardness 70 Shore A
Test Fixture P/N 179-253 Change ---
O-Ring Squeeze 32.8%

Time Hrs.	Temperature °F	Leakage Rate cc/min	Comments
0	Ambient	---	
23	-65	---	
42	-65	---	Opened Cold Box for 20 Minutes
44	-65	---	Opened Cold Box for 20 Minutes
44 Hrs. 20 Min.	---	.8	16 cc/20 min.
45	---	1.0	16 cc/15 min.
48	---	Nil	Stopped Test
Repeated Test			
0	Ambient	---	
64	-65	---	1 cc/64 hrs.
65.5	-65	---	Warm Box
+15 min	30	---	
+25 min	---	---	Turned Cold Box On
+5 min	---	2.2	11 cc/5 min.
70.0	-65	---	1 cc/4 hrs.

Data Sheet No. 2

Test No. 2 Date 11-17-71
Seal 68-185 (Repeat with New Seal)
Compound Parker E600-7 Hardness 70 Shore A
Test Fixture P/N 179-253 Change ----
O-Ring Squeeze 32.8%

Time Hrs.	Temperature °F	Leakage Rate cc/min	Comments
0	Ambient	---	
18	-65	0	
23	Ambient	0	
Repeated Test			
0	Ambinent	0	
26	-65	0	Disassembled to Replace Outer O-Ring
Repeated Test			
0	Ambient	0	
2.0	Ambient	---	16 cc/1.5 hrs.
5.0	-65	---	
25.0	-65	---	
29.0	-65	---	Turned Heat on for 15 Minutes
+15	---	---	Turned Cold Box On
46	-65	---	Stopped Test



Aerospace Standard AS666A
Configuration for Tests 3 and 4
Date - 2-7-72

Test Fixture P/N 179-253, Chg. "A"
O-Ring P/N 68-185 Dia. .210

Data Sheet No. 3

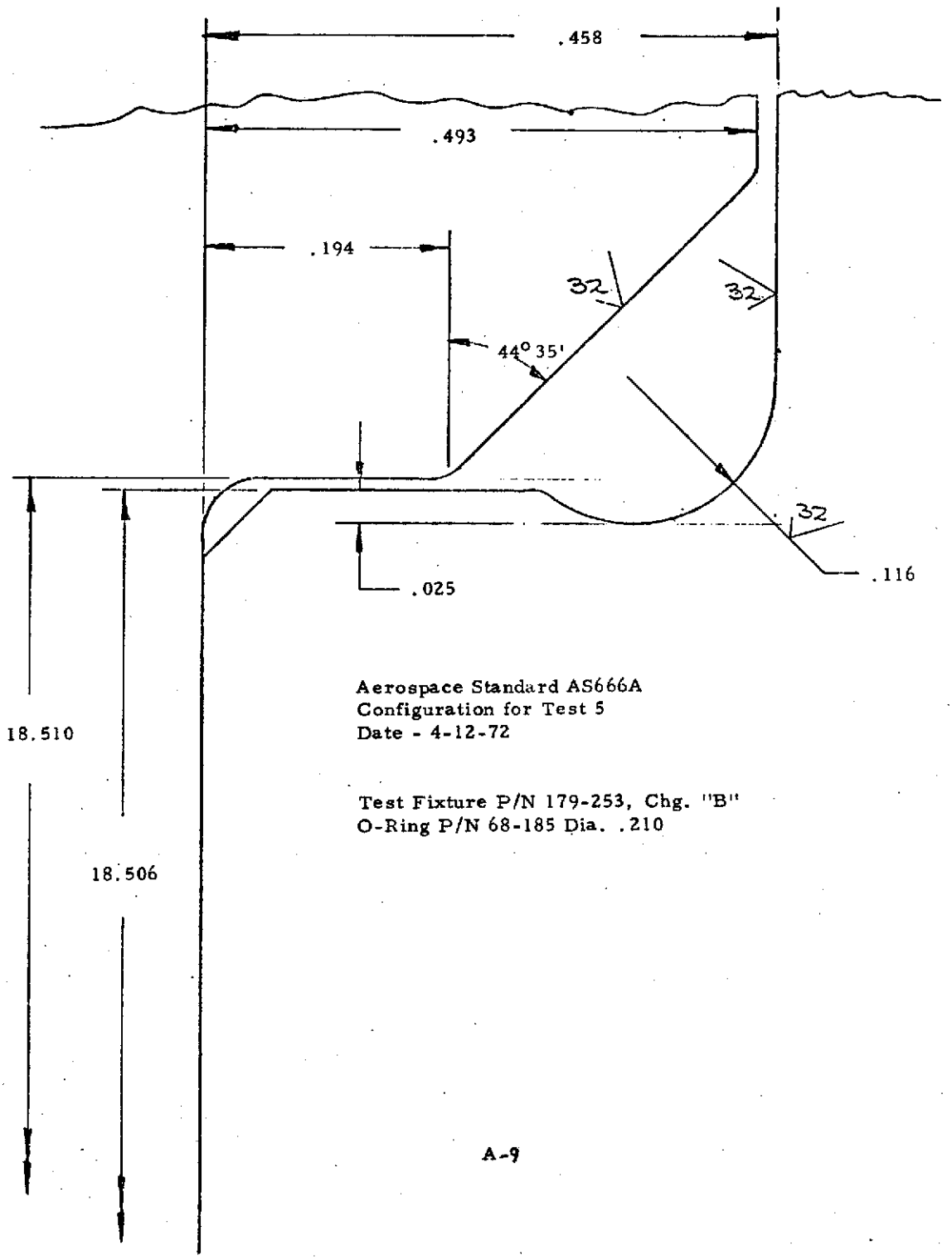
Test No. 3 Date 2-7-72
Seal 68-185
Compound Parker E600-7 Hardness 70 Shore A
Test Fixture P/N 179-253 Change A
O-Ring Squeeze 26.6%

Time Hrs.	Temperature °F	Leakage Rate cc/min	Comments
0	Ambient	---	
24	-65	0	Turned Heat on for 15 Minutes at 300°F
+15 Min	---	1.7 cc/min	Started Cooling to -65°F
+25 Min	-65	0	Leakage Stopped
48	-65	0	Stopped Test

Data Sheet No. 4

Test No. 4 Date 2-23-72
Seal 68-185 (Repeat with New Seal)
Compound Parker E600-7 Hardness 70 Shore A
Test Fixture P/N 179-253 Change A
O-Ring Squeeze 26.6%

Time Hrs.	Temperature °F	Leakage Rate cc/min	Comments
0	Ambient	0	
24	-65	.4 cc/min	
41.5	-65	0	Turned Heat on for 15 Minutes at 300°F
+15 min	---	0	Started Cooling to -65°F
137.5	-65	0	Stopped Test



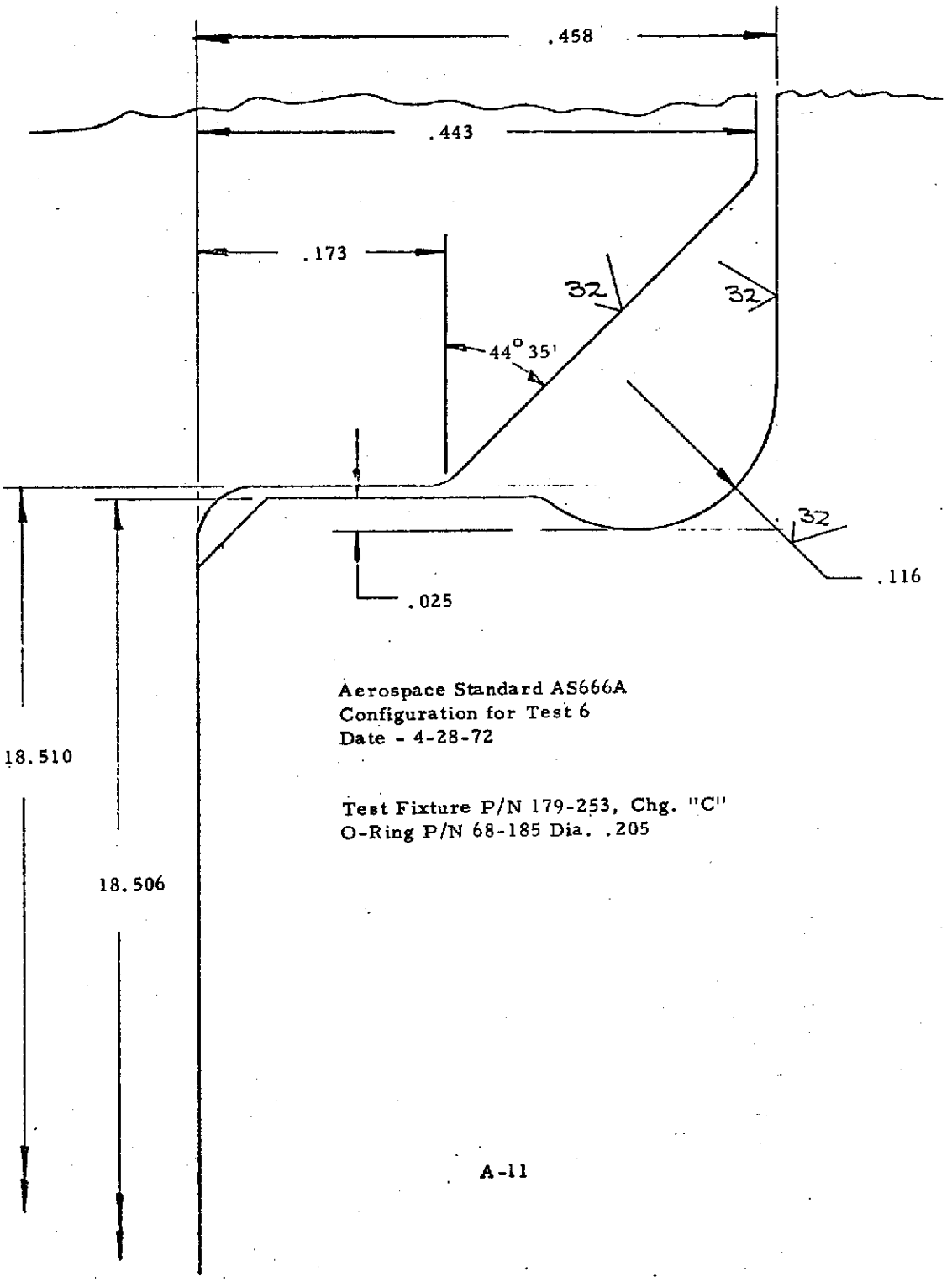
Aerospace Standard AS666A
Configuration for Test 5
Date - 4-12-72

Test Fixture P/N 179-253, Chg. "B"
O-Ring P/N 68-185 Dia. .210

Data Sheet No. 5

Test No. 5 Date 4-12-72
Seal 68-185
Compound Parker E600-7 Hardness 70 Shore A
Test Fixture P/N 179-253 Change B
O-Ring Squeeze 23%

Time Hrs.	Temperature °F	Leakage Rate cc/min	Comments
0	Ambient	0	
18	-65	0	Turned Heat on for 15 Minutes at 300°F
+15 min	---	.6 cc/min	Started Cooling to -65°F
24	-65	0	Stopped Test



Aerospace Standard AS666A
Configuration for Test 6
Date - 4-28-72

Test Fixture P/N 179-253, Chg. "C"
O-Ring P/N 68-185 Dia. .205

Data Sheet No. 6

Test No. 6 Date 4-28-72

Seal 68-185

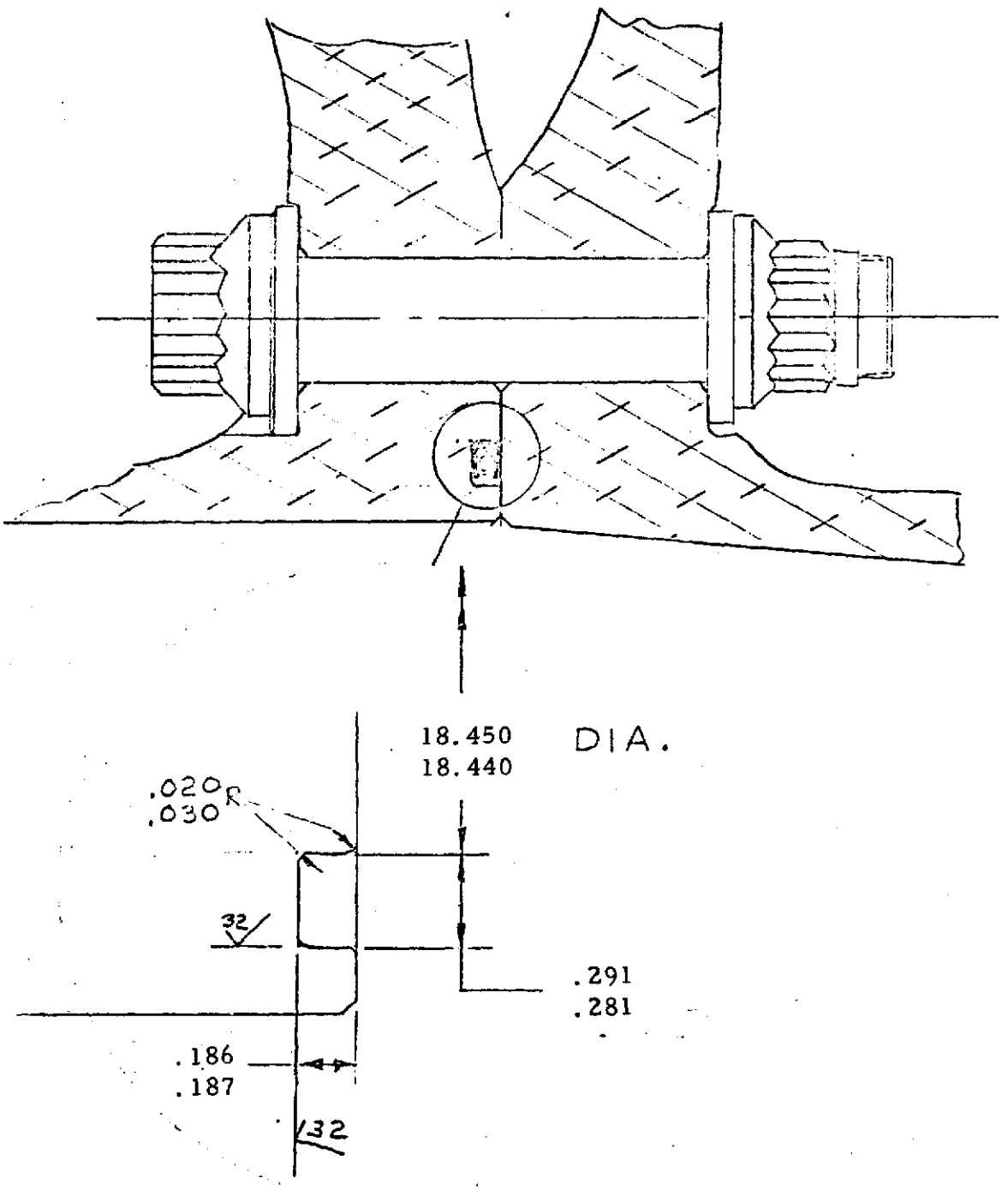
Compound Parker E600-7 Hardness 70 Shore A

Test Fixture P/N 179-253 Change C

O-Ring Squeeze 15%

Time Hrs.	Temperature °F	Leakage Rate cc/min	Comments
0	Ambient	0	
69	-65	0	Turned Heat on For 15 Minutes at 300°F
-15	---	0	
101	-65	0	Stopped Test

Omniseal Test Configuration
P/N AR214D18450A1Q
Test Fixture P/N 179-257, Chg. -
Configuration for Test 7

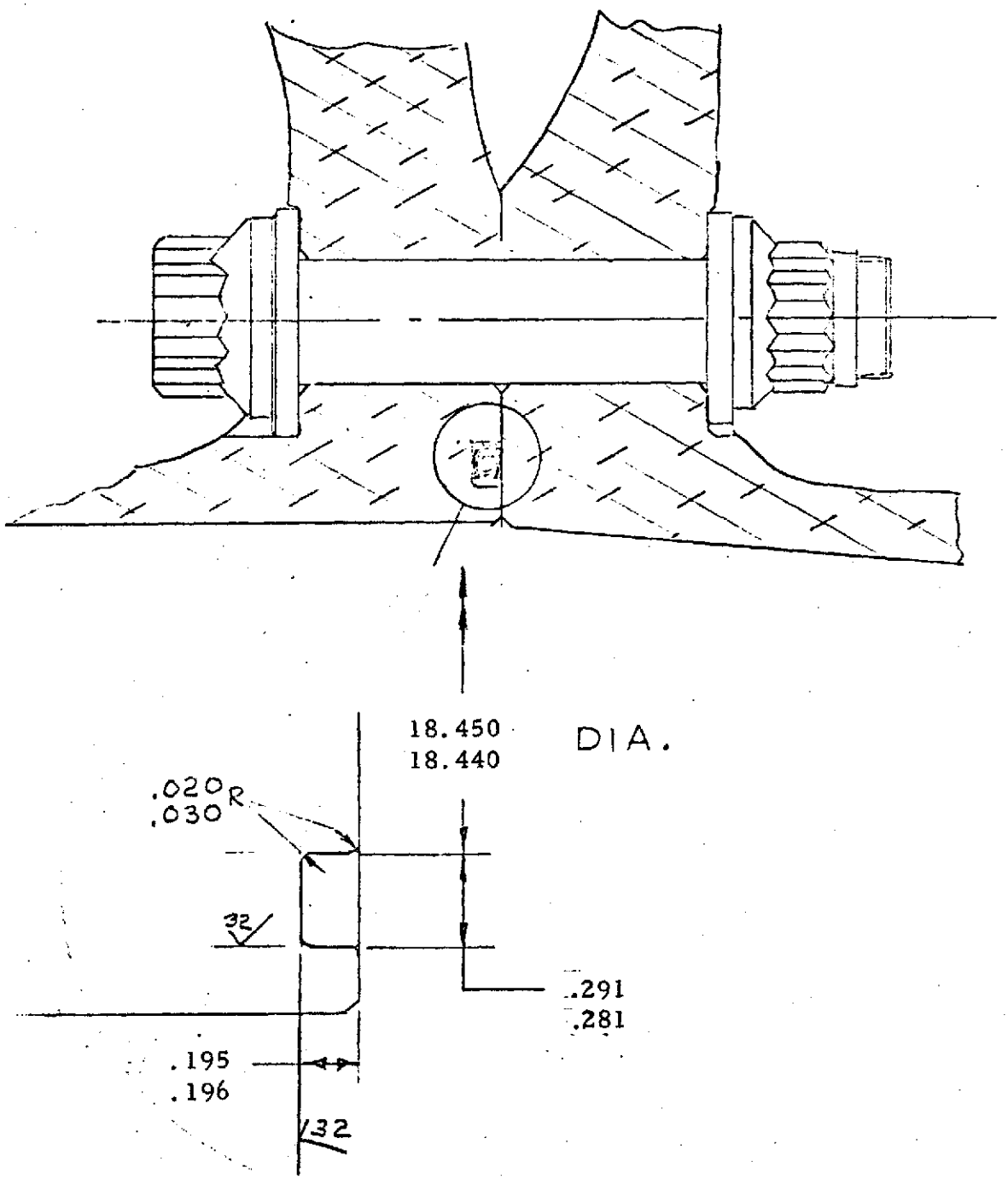


Data Sheet No. 7

Test No. 7 Date 3-15-72
Seal Omniseal AR214D18450A1Q
Compound
Test Fixture P/N 179-257 Change ---

Time Hrs.	Temperature °F	Leakage Rate cc/min	Comments
0	Ambient	0	
23	-65	0	Turned Heat on for 15 Minutes at 300°F
+15 min	---	0	Started Cooling to -65°F
47	-65	0	
119	-65	0	Stopped Test

Omniseal Test Configuration
P/N AR214D18450A1Q
Test Fixture P/N 179-257, Chg. A
Configuration for Test 8



Data Sheet No. 8

Test No. 8 Date 4-11-72

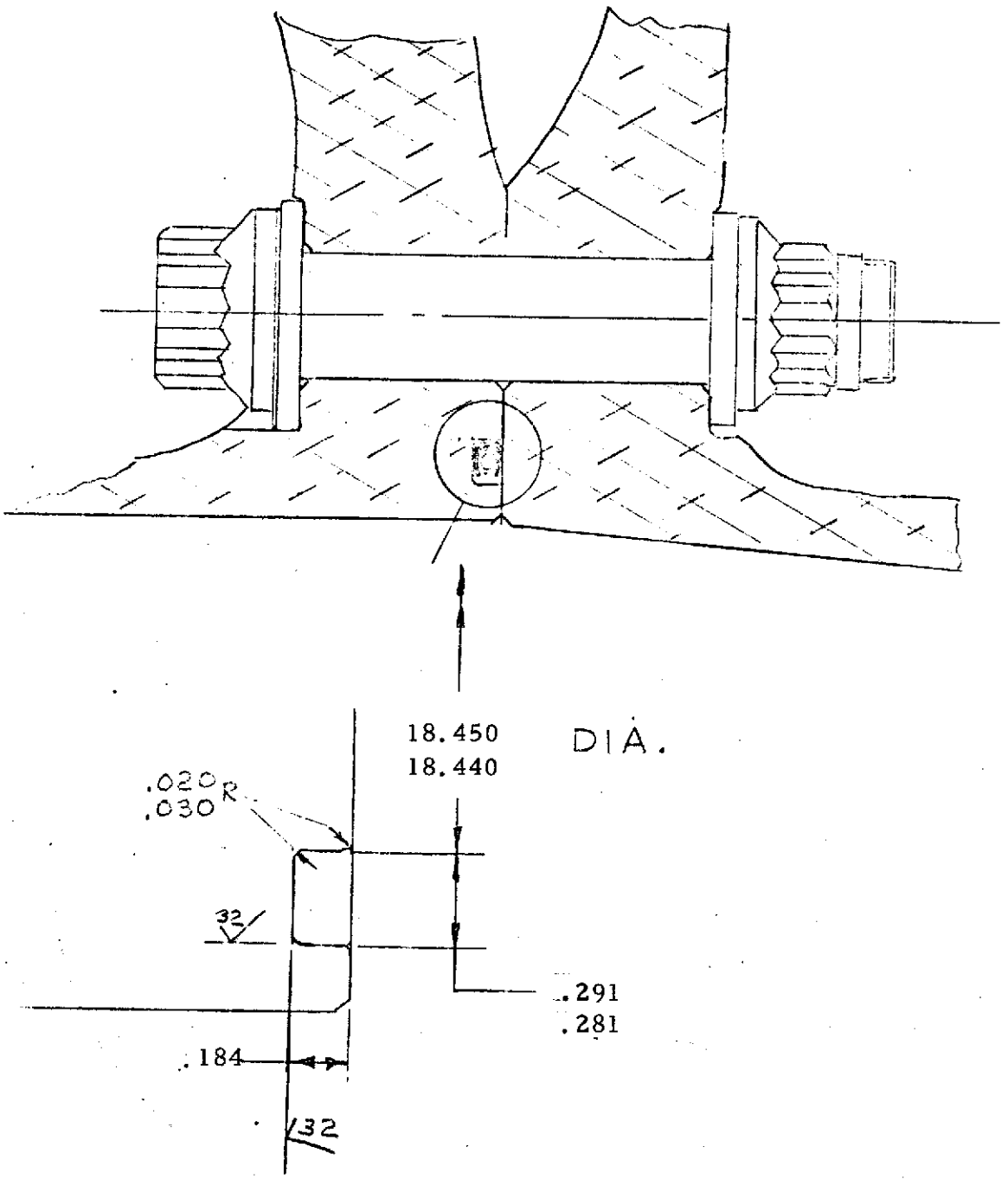
Seal Omniseal AR 214D18450A1Q

Compound

Test Fixture P/N 179-257 Change A

Time Hrs.	Temperature °F	Leakage Rate cc/min	Comments
0	Ambient	0	
1.5	-15°F	---	Started to Leak
2.0	-35°F	4 cc/min	
2.5	-50°F	7 cc/min	Stopped Test

Omniseal Test Configuration
P/N AR214D18450A1Q
Test Fixture P/N 179-257, Chg. B
Configuration for Test 9



Data Sheet No. 9

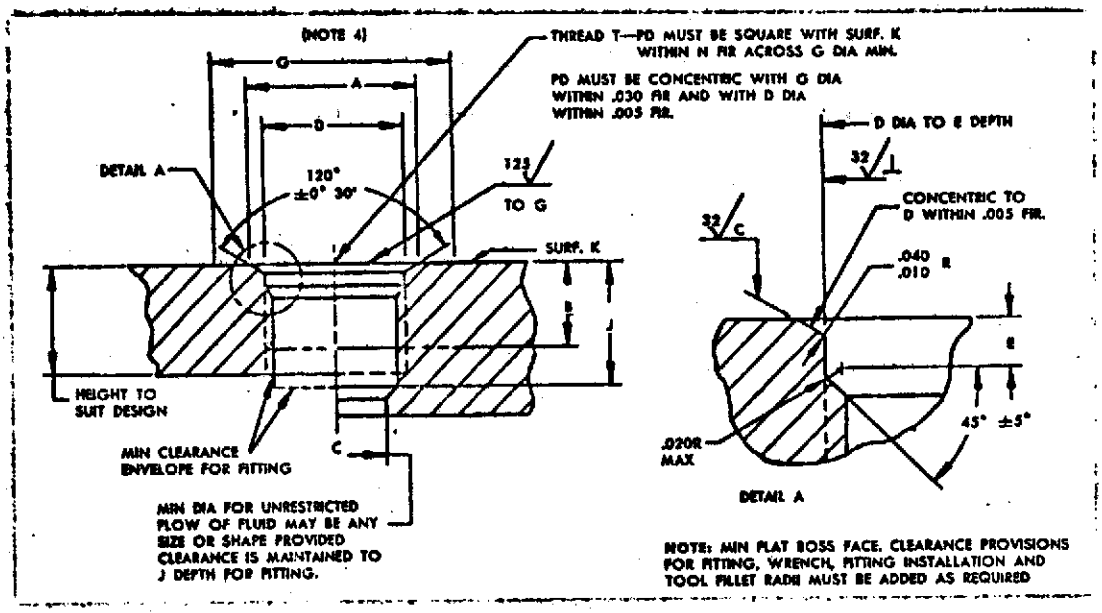
Test No. 9 Date 4-27-72

Seal Omniseal AR 214D18450A1Q

Compound

Test Fixture P/N 179-257 Change B

Time Hrs.	Temperature °F	Leakage Rate cc/min	Comments
0	Ambient	10 cc/min.	Stopped Test



DESIGN CHART 7-3

Boss Dimensions For Military Straight Thread Tube Fitting O-ring Gaskets

Per MS33649 (Supersedes AND10049 and AND10050)

For MS9020, MS9355, MS28778 (AN6290), MS29512 and NAS617 Gaskets

Parker O-ring Size No.*	Actual O-ring Dimensions W	Actual O-ring Dimensions ID	Equivalent Tube Dash No.	Tube OD Nom.	Thread T Per MIL-S-8879	A Dia +.015 −.000	B Min Full Thd Depth	C Dia	D Dia +.015 −.000	E +.015 −.000	G Dia Min	J Min	N
3-902	.064±.003	.239±.005	2	.125	.3125-24UNJF-3B	.438	.482	.062	.328	.063	.602	.577	.003
3-903	.064±.003	.301±.005	3	.188	.3750-24UNJF-3B	.500	.538	.125	.390		.665	.583	
3-904	.072±.003	.351±.005	4	.250	.4375-20UNJF-3B	.562	.568	.172	.454	.075	.728	.636	
3-905	.072±.003	.414±.005	5	.312	.5000-20UNJF-3B	.625		.234	.517		.790		
3-906	.078±.003	.468±.005	6	.375	.5625-18UNJF-3B	.688	.598	.297	.580	.083	.852	.709	.004
3-907	.082±.003	.530±.005	7	.438	.6250-18UNJF-3B	.750	.614	.360	.643	.094	.915	.725	
3-908	.087±.003	.644±.005	8	.500	.7500-16UNJF-3B	.875	.714	.391	.769		1.040	.834	.005
3-909	.097±.003	.706±.005	9	.562	.8125-16UNJ-3B	.938	.730	.438	.832	.107	1.102	.850	
3-910	.097±.003	.755±.005	10	.625	.8750-14UNJF-3B	1.000	.802	.484	.896		1.165	.930	
3-911	.119±.004	.863±.005	11	.688	1.0000-12UNJF-3B	1.156	.877	.547	1.023	.125	1.352	1.064	
3-912	.116±.004	.924±.006	12	.750	1.0625-12UNJ-3B	1.234		.609	1.086		1.415		
3-914	.116±.004	1.047±.006	14	.875	1.1875-12UNJ-3B	1.362		.734	1.211		1.540		
3-916	.116±.004	1.171±.006	16	1.000	1.3125-12UNJ-3B	1.487		.844	1.336		1.665		.008
3-918	.116±.004	1.355±.006	18	1.125	1.5000-12UNJF-3B	1.675		.953	1.524		1.790	1.116	
3-920	.118±.004	1.475±.010	20	1.250	1.6250-12UNJ-3B	1.800		1.078	1.648		1.978		
3-924	.118±.004	1.720±.010	24	1.500	1.8750-12UNJ-3B	2.050		1.312	1.898		2.228	1.127	.010
3-928	.118±.004	2.090±.010	28	1.750	2.2500-12UNJ-3B	2.425		1.547	2.273		2.602	1.243	
3-932	.118±.004	2.337±.010	32	2.000	2.5000-12UNJ-3B	2.675	.907	1.781	2.524		2.852	1.368	

*PARKER DASH NUMBERS CORRESPOND WITH THOSE OF MS9020, MS9355, MS28778 (AN6290), MS29512, and NAS617.

Data Sheet No. 10

Test No. 10 Date 9-21-71
Seal MS28778-4
Compound
Test Fixture P/N 179-255 Change ---

Time Hrs.	Temperature °F	Leakage Rate cc/min	Comments
0	Ambient	.20	
27	-65	0	Stopped Test

Data Sheet No. 11

Test No. 11 Date 10-7-71
Seal MS28778-4 (Repeat with New O-Ring)
Compound
Test Fixture P/N 179-255 Change ---

Time Hrs.	Temperature °F	Leakage Rate cc/min	Comments
0	Ambient	0	
3	-65	---	1 cc/3 hrs.
15	-65	---	2 cc/15 hrs.
Repeated Test			
0	Ambient	---	
7	-65	---	(Opened Cold Box for 5 Minutes)
7 + 5 min	-65	---	
9	-65	---	Stopped Test

APPENDIX B

NASA ENVIRONMENTAL TESTING OF WHEEL AND TIRE ASSEMBLY

Introduction

Wheel seal assemblies passing the -65°F temperature requirements were assembled into two wheel and tire assemblies and tested at NASA, Houston, Texas, to the space shuttle type environmental requirements. Appendix "B" presents the wheel and tire assembly description and the corresponding environmental test data.

Test Procedure

The wheel and tire assemblies were inflated to 312 psig and allowed to set for a period of 24 hours to allow for tire growth. The inflation pressure was readjusted to 312 psig and the environmental test was started.

The pressure of the test chamber was lowered to 10^{-5} torr and its temperature lowered to -65°F. The test lasted for a period of 184 hours from the time the pressure and temperature in the test chamber started dropping until the time the tire temperature stabilized at room temperature at the end of the test.

Test Configuration

Wheel and Tire Assembly #1

A.	Wheel Assembly	B. F. Goodrich P/N 3-1342-1, except without bearing, heat shields, wheel inserts, and fuse plugs.
B.	Split Wheel Air Seal	Omniseal Configuration as shown on page B-3, P/N AR214D18450A1Q
C.	Inflation Valve Seal	MS-33649 Configuration
D.	Tire	C5A Tire Manufactured by B. F. Goodrich, S/N 2098AK0736

Test Configuration (Cont'd)

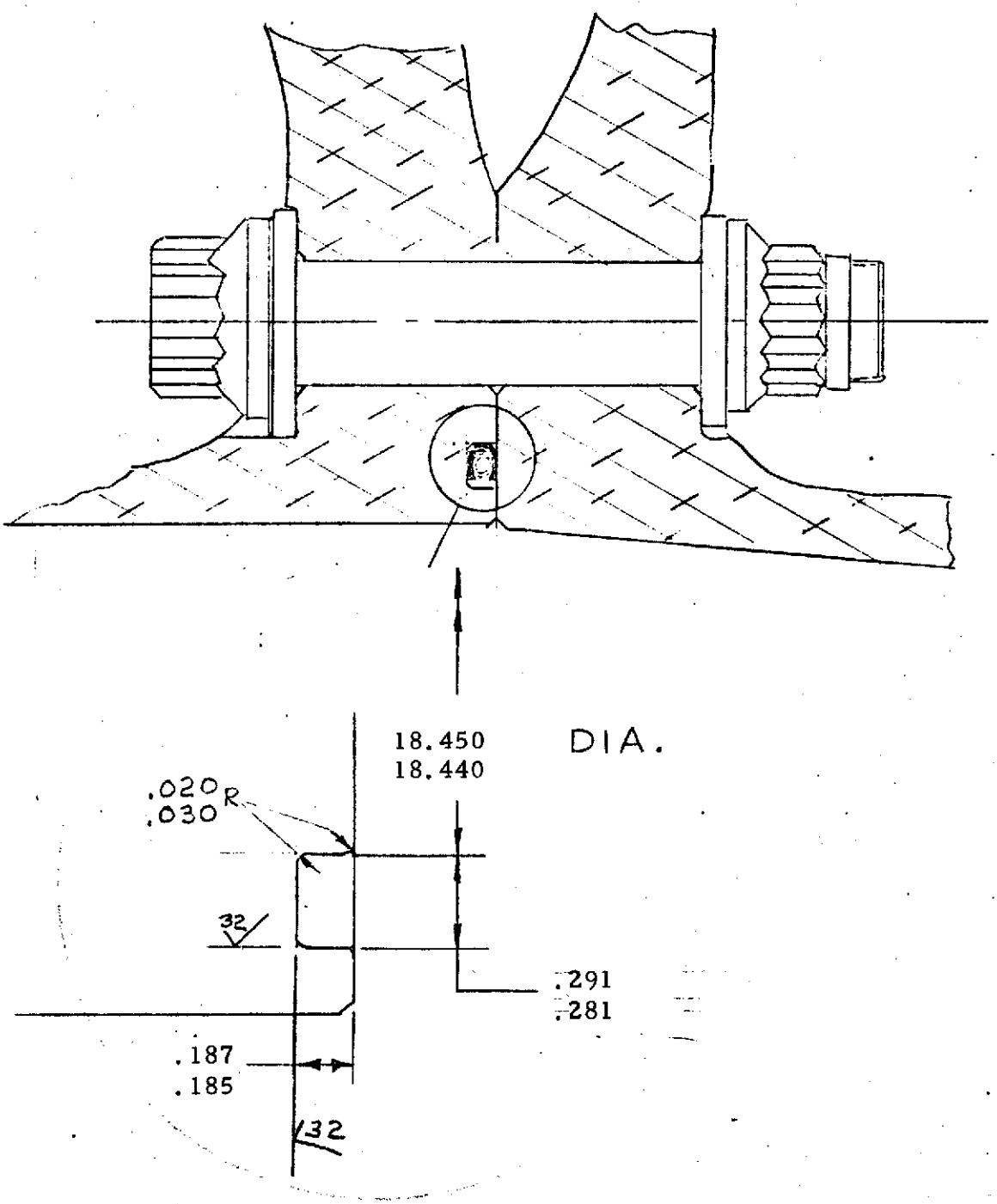
Wheel and Tire Assembly No. 2

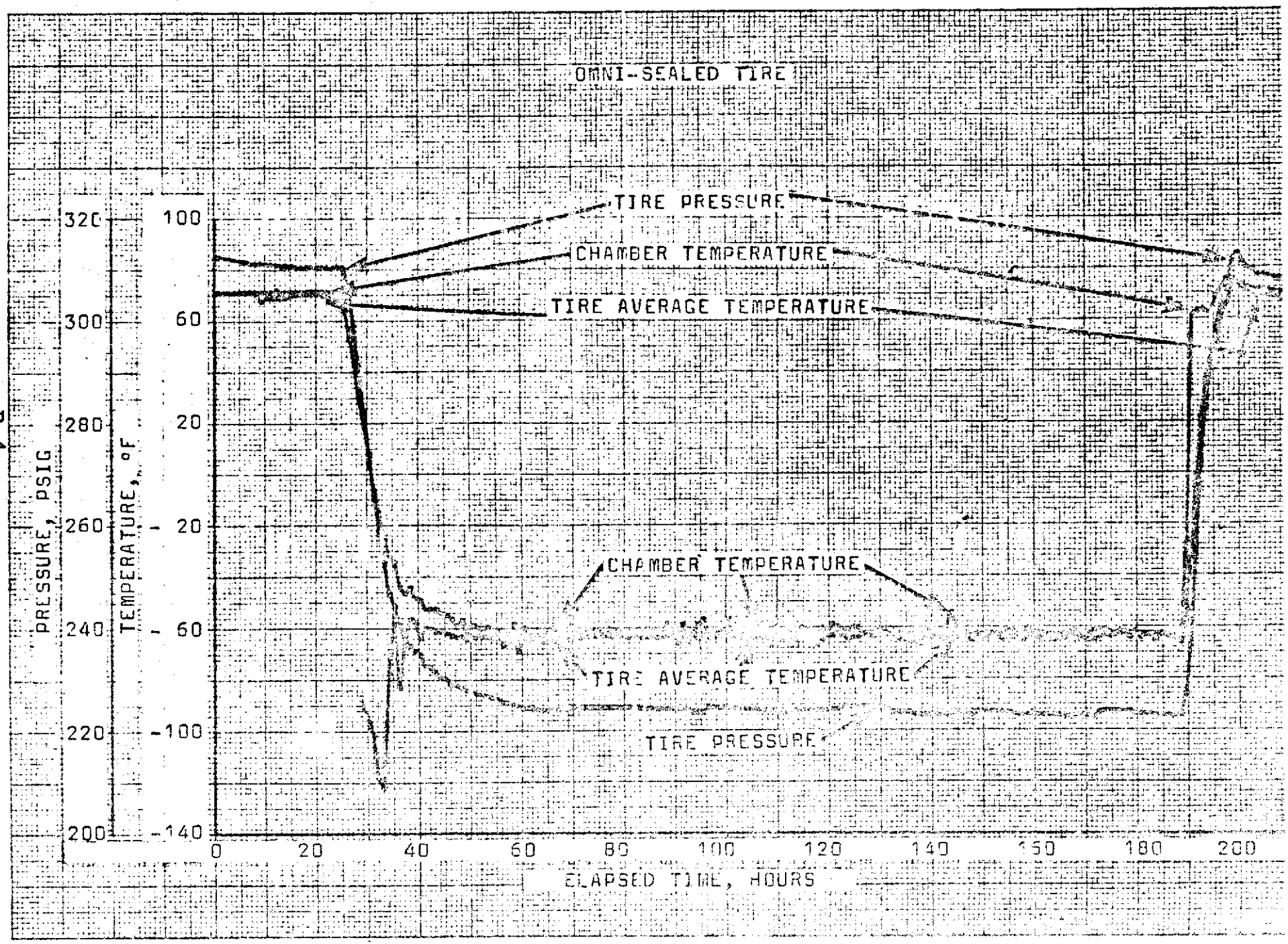
A.	Wheel Assembly	B.F.Goodrich P/N 3-1342-1, except without bearings, heat shields, and wheel inserts.
B.	Split Wheel Air Seal	P/N AS666A, as shown on page B-5 using 29.7% O-ring squeeze. O-ring P/N 68-185
C.	Inflation Valve and Fuse Plug Seals	MS-33649 Configuration
D.	Tire	C5A Tire Manufactured by B.F.Goodrich S/N 2098AK0190

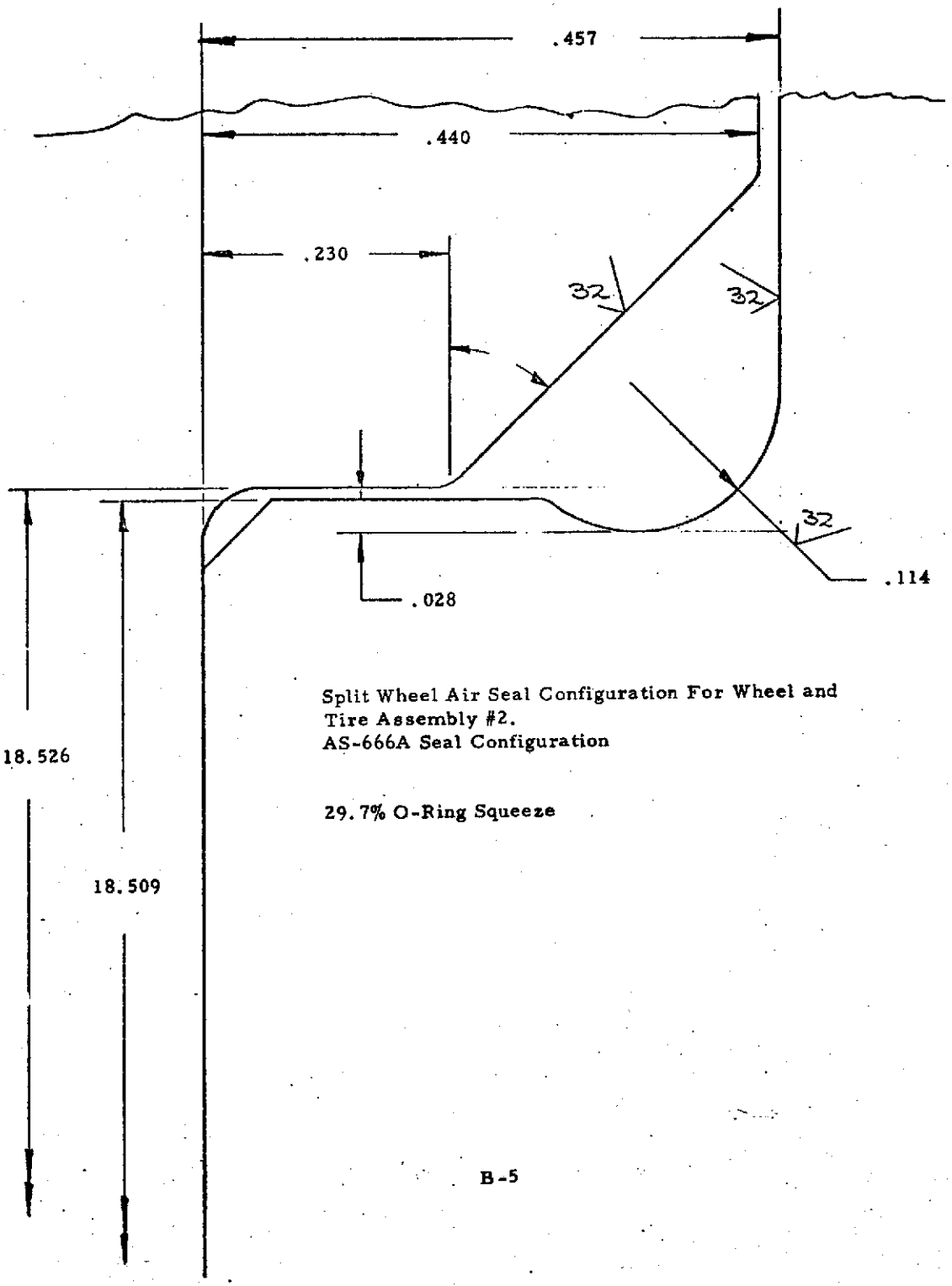
Test Results

Wheel and Tire Assembly Nos. 1 and 2 lost 4.0 psi and 3.0 psi or 1.28% and 1.0% of the original tire pressure respectively during the 184 hour test period. The allowable pressure loss was 5% of the original tire pressure. The test data is plotted on graphs on pages B-4 and B-6.

Split Wheel Air Seal Configuration
For Wheel and Tire Assembly No. 1
Omniseal P/N AR214D18450A1Q

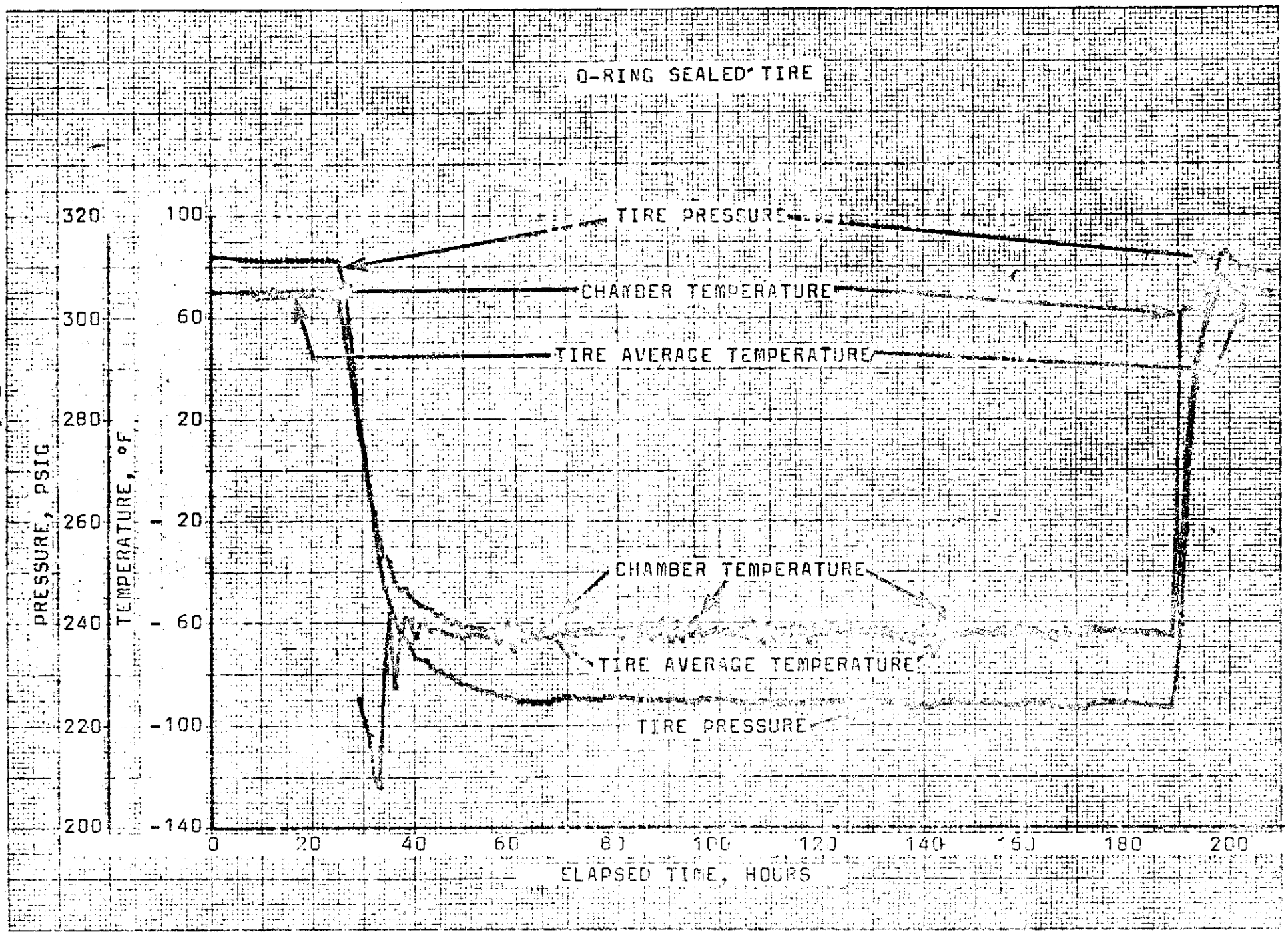



OMNI-SEALED TIRE
TIRE PRESSURE
CHAMBER TEMPERATURE
TIRE AVERAGE TEMPERATURE
CHAMBER TEMPERATURE
TIRE AVERAGE TEMPERATURE
TIRE PRESSURE
PRESSURE, PSIG
320
300
280
260
240
220
200
TEMPERATURE, °F
100
60
20
20
60
-100
-140
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME, HOURS



Split Wheel Air Seal Configuration For Wheel and Tire Assembly #2.
AS-666A Seal Configuration

29.7% O-Ring Squeeze


O-RING SEALED TIRE
TIRE PRESSURE
CHAMBER TEMPERATURE
TIRE AVERAGE TEMPERATURE
CHAMBER TEMPERATURE
TIRE AVERAGE TEMPERATURE
TIRE PRESSURE
PRESSURE, PSIG
TEMPERATURE, °F
320
300
280
260
240
220
200
100
60
20
-20
-60
-100
-140
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME, HOURS